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COMMENTARY

MONETARY POLICY

The Missing Links:
Better Measures of Inflation and Inflation Expectations in Canada

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In this issue...

Canada's current Consumer Price Index yields a biased and unnecessarily imperfect measure of inflation. New measures of inflation and inflation expectations would provide more accurate, useful guides for the Bank of Canada's inflation-targeting regime, post-2011.

THE STUDY IN BRIEF

In 2011, the inflation-targeting framework that guides Canadian monetary policy will be 20 years old and will be due for renewal and possible revision. This *Commentary* deals with the question of how to measure the price level underlying the inflation rate that the Bank of Canada targets. It argues that monetary policy can depend in important ways upon which price index is used in the inflation target and also upon which indexes the Bank uses as sources of information. It reviews the arguments for various choices of target price index and the lessons yielded by recent research, both on price-level measurement *per se* and on optimal monetary policy. It argues that Canada's current CPI yields a biased and unnecessarily imperfect measure of inflation, and looks at ways in which a more accurate and useful price index could be created. It also assesses the usefulness of core inflation as a source of information for monetary policymakers. The *Commentary* concludes by recommending that, in future, the Bank of Canada pursue targets for the behaviour of a new, chained, superlative price index to be created by Statistics Canada. It also recommends an extension of the range of inflation-indexed government bonds available to the public, to improve the quality of market-generated information about the likely future course of inflation. A survey of the inflation predictions of private sector forecasters would complement this step, and so enhance the measurement of the inflation expectations that play a key role in designing good monetary policy.

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INDEPENDENT • REASONED • RELEVANT

An inflation-targeting framework has guided Canadian monetary policy since 1991. In 2006, the federal government and the Bank of Canada renewed this framework until 2011, with a target range between 1 and 3 percent for the inflation rate and a goal of keeping inflation near the 2 percent midpoint.

At the same time, the Bank announced it was researching whether the framework should be revised in 2011, when it will be 20 years old. Since we are now less than two years from that proposed revision, it seems a propitious time to investigate all aspects of Canadian monetary policy.

One possible decision for 2011 would be to continue with the current framework. Another would be to revise the inflation target – for example, to use a range with a lower midpoint of, say, 1 percent. The Bank of Canada also is investigating a third possibility: price-level targeting, sometimes also called price-level-path targeting. Under this regime for monetary policy, the Bank's goal would be to keep the price level near a predictable path – perhaps involving growth at 2 percent per year. If the price level rose faster than the path – that is, by more than 2 percent – in one year, then the Bank would try to ensure that it grew more slowly than that in the following year so as to return to the original, planned path. So bygones would not be bygones under price-level-path targeting: a high inflation rate in one year would be offset by a low inflation rate thereafter. Inflation targeting, in contrast, does not have this feature.

According to some economic analyses, price-level-path targeting might simplify some decisions for firms and households and lead to a more stable economy overall, so it is the subject of careful research, especially because the historical experience with such schemes is rather limited.[1] Whatever regime for monetary policy the Bank of Canada and the Government of Canada adopt, however, their plan, or targeting framework, will become concrete only with the choice of a price index with which to measure the inflation rate or track the path. This *Commentary* investigates that choice.

I begin by looking at what happens now, both in Canada and in several other countries. I then review the arguments for various choices of price index, and briefly discuss the treatment of the prices of houses and other assets. I next discuss lessons from economic research on optimal monetary policy and the advantages and disadvantages of using core inflation as an operational guide.

This review leads to two categories of recommendations for the Bank of Canada, the Department of Finance, Statistics Canada, and economic forecasters. First, I outline several ways in which the consumer price index (CPI) could be improved and supplemented. My most radical recommendation is that the Bank target the inflation rate using a new, chained, superlative price index, which I define below, rather than the traditional CPI. Second, I describe the need for a measure of forecasted, or expected, inflation as a guide for monetary policy.

I call these two types of missing information "missing links," because they would fit between the instrument of monetary policy (the Bank's target for the overnight interest rate) and its ultimate goal of delivering low and predictable inflation. Currently, the CPI inflation rate is subject to systematic measurement error that is quite large as a proportion of the well-known 2 percent target. So improving or replacing the CPI to reduce this error would allow the Bank, and Bank-watchers, to track its record better.

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1 Koeppl (forthcoming, 2009) discusses possible reforms to Canadian inflation targeting, while Boivin (forthcoming, 2009) discusses how uncertain measurement of inflation affects the choice between that regime and price-level targeting.

Forecasts or expectations of inflation are the second missing link because monetary policy acts on the inflation rate with a lag – sometimes estimated to be about 18 months in Canada. As a result of this lag, the Bank of Canada tries to adjust the overnight interest rate to offset events that would otherwise lead to a future inflation rate that differs from the 2 percent midpoint of the target range. The Bank can react to all sorts of information and current events, but a natural focus or operational guide is an index of expected inflation that aggregates or weights all these indicators automatically.

Expected inflation has three very appealing properties as a guide to policy. First, by definition, it mechanically predicts subsequent inflation, which is the target. We might each have our own forecast or expectation of future inflation, but I refer here to a consensus expectation calculated in a bond market or by averaging professional forecasts, for example. Such consensus measures have good forecasting track records.

Second, and more subtly, expected inflation partly determines the inflation rate over the medium term by influencing price-setting decisions. This is an additional reason economists and central bankers think measuring these expectations is important. In fact, in June 2008, several central banks, including the European Central Bank, the US Federal Reserve, and the Bank of England, took pains to communicate their view that expected inflation matters more for the evolution of the inflation rate than do changes in relative prices such as those of corn or gasoline. They emphasized this effect to counter suggestions that spikes in commodity prices necessarily lead to higher overall inflation. Overall, this influence of expected inflation on actual inflation means that monetary policy involves the management of expectations. Indeed, some commentators recommend that central banks explicitly target the expected, future inflation rate.

Third, expected inflation responds to changes in the overnight interest rate. When expected inflation is high (say, above 2 percent) and the overnight interest rate rises, expected inflation then falls. Using expected inflation as an operational guide thus leads to stable inflation in the future.

All this implies that the Bank of Canada could use an index of expected inflation as an operational guide, and observers of monetary policy could also use information on expected inflation to predict the likely effects of monetary policy and to evaluate the track record and stance of the central bank. In Canada, however, we currently have no widely accepted measure of expected inflation, so that is the second missing link between the Bank's instrument and its ultimate target.

If we lack a good measure of expected inflation, how can one be so sure that it predicts subsequent inflation, affects current price-setting decisions, and responds to policy changes? We know about these properties from measurements of expected inflation in other countries. For example, the well-developed indexed debt market in the United Kingdom yields market-based measures, while the *Survey of Professional Forecasters* in the United States provides a consensus survey measure. As I discuss below, however, the Canadian market for indexed debt is too narrow to generate reliable data and the use of forecast surveys in Canada also is poorly developed. Canadian macroeconometricians do observe expected inflation indirectly in econometric models. But both the practice and the assessment of monetary policy could be improved with the explicit measurement of inflation expectations.

What Happens Now

Before seeing how these links fit in, let us review what happens currently. I noted above that the Bank of Canada has a target range for the inflation rate of 1 to 3 percent, with a goal of keeping inflation near the 2 percent midpoint. The inflation rate is measured as the year-to-year growth rate in the CPI, which is produced monthly. Other inflation-targeting central banks do roughly the same thing – indeed, both the Bank of England and Sweden's Riksbank have these same targets and bands. The Reserve Bank of Australia has a target of 2 to 3 percent on average over the economic cycle; the Banco Central do Brasil's target for 2009 is 4.5 percent, with a range of 2.5 to 6.5 percent; the Banco de México's target is 3 percent; the Swiss National Bank has a target of less than 2 percent,

though it also monitors measurement bias in the rate of inflation; and the Bank of Korea currently has a 3 percent target, with a range of 2.5 to 3.5 percent for a three-year average of the inflation rate. As with all inflation-targeting central banks, each of these inflation rates is measured using the national CPI. [2]

Basics of the Consumer Price Index

A price index is a weighted average of the prices of individual goods and services. In Canada, the CPI is based on roughly 600 goods and services that feature in an average household's spending on things such as food, housing, transportation, furniture, clothing, and recreation. The weights on prices are based on expenditure shares, sometimes collectively called the basket of goods and services in the CPI. So, if groceries make up 25 percent of a typical household's spending, for example, then the weight on groceries will be 0.25. One way to find a basket is to use survey data on consumer spending from the past. The resulting weights then are used to find the price of the overall basket in the past, and the same weights are used to find the price of the basket today. The annual percentage growth rate of the resulting index, or weighted average, is what we usually mean by the phrase "CPI inflation rate." The technical shorthand for this way of finding a basket – that is, using an expenditure pattern from the past – is to refer to it as a Laspeyres index, after German economist Étienne Laspeyres (1834-1913), who first proposed it. Statistics Canada uses exactly this method, except that it updates the weights every four years using information on expenditure from the *Survey of Household Spending*. The weights were last updated in May 2007 using spending patterns from 2005.

CPI inflation is a natural target for several reasons. Since the CPI is used in the tax system and in wage setting, it is the price index most familiar to the public. As well, it is produced monthly, is not subject to revisions, and is released quickly after the month to which it applies (about three weeks into the subsequent month).

Biases in the CPI

Although the CPI is popular with inflation-targeting central banks, index-number specialists have long been aware of its shortcomings as a measure of the cost of living. These shortcomings have become more widely known in part due to the 1996 Advisory Commission to Study the Consumer Price Index (more commonly known as the Boskin Commission) in the United States.

One of the CPI's shortcomings arises automatically because it is based on past or lagged expenditure weights. If consumers tend to shift their spending away from goods with rapidly rising prices, then the inflation rate they experience will be less than the one that was calculated using their old spending pattern. Since the CPI inflation rate uses the old spending pattern, it overstates the increase in the cost of living by not allowing for substitution over outlets (say, toward Internet shopping) or commodities (say, toward turnips when broccoli prices rise). This syndrome is referred to as substitution bias. One way to avoid this bias might be to use a present-day basket to weight prices, a method that yields a measure called a Paasche index, after another German economist, Hermann Paasche (1851-1925). But the inflation rate measured with a Paasche index displays the mirror image of the problem of the Laspeyres index by tending to *understate* the inflation rate in the cost of living.

The second main bias in the CPI arises because of changes in the quality of goods and services or the introduction of new goods and the disappearance of old ones. For example, the current basket includes some consumer goods built around cathode ray tubes, which play a declining role in household spending. A variety of statistical techniques exist, however, for adjusting for new goods and changes in quality.[3]

2 Siklos (forthcoming, 2009) describes international experiences with inflation targeting.

3 This is an active area of research, as described in the authoritative manual issued by the International Labour Office et al. (2004).

How Large Are the Biases?

The Bank of Canada studies and periodically reports on the biases in CPI inflation. One such study, by Rossiter (2005), estimates that the 12-month CPI inflation rate overstates cost-of-living inflation by 0.6 of a percentage point *on average*. Thus, the official 1 to 3 percent target range for CPI inflation implies a band between 0.4 and 2.4 percent (on average) for the growth rate of this underlying cost. An interesting feature of this estimate is that the biases in the CPI inflation rate do not seem to be trending over time, so it is fairly easy for the Bank simply to adjust its target range for the largest value of the bias that has been observed in the past. If the largest bias were 1 percentage point, for example, then setting the floor of the target range at 1 percent, and never falling below that rate, would avoid deflation in the cost of living.

Of course, this bias does accumulate over time in the level of the CPI. Within a four-year period between resettings of the CPI basket, a pioneering central bank that targeted the path of the price level would be subject to increased substitution bias. At a minimum, reformulating the existing CPI by updating its basket more frequently would be indispensable under price-level-path targeting. Even better, using a real-time index designed to adjust for substitution bias would be a natural complement to price-level-path targeting.

How to Avoid Substitution Bias

One way to avoid substitution bias, and so measure the inflation rate accurately, is to follow Diewert's (1998b) suggestion to take the geometric average of the Laspeyres and Paasche indexes, which produces what is called the Fisher ideal price index, after US economist Irving Fisher (1867-1947). Just to complete our guide to the terminology, indexes such as this one, which combine the two traditional measurements and are immune to substitution bias, are sometimes called *superlative* indexes. However, statistical agencies do not report, and central banks do not target, the Fisher ideal index because current expenditure patterns – the weights in a Paasche index – are known only with a significant lag, which makes it less timely than the traditional CPI. Thus, if one were to adopt such an index, the choice would be between delaying the release of the index (which seems bad) or making it subject to significant revisions (which also seems bad).

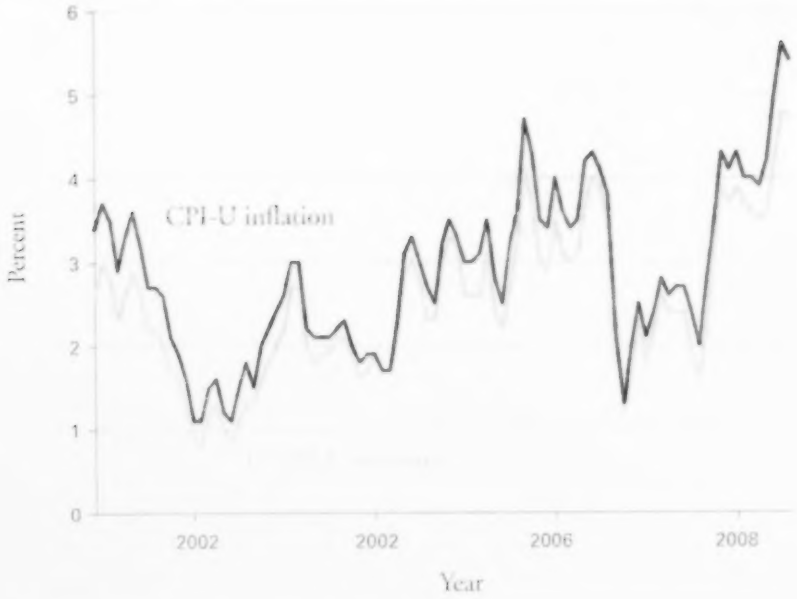
There is, however, a real-time, monthly index – constructed for the United States by Shapiro and Wilcox (1997) – that minimizes substitution bias. This index uses lagged expenditure weights and a technical assumption about household budgeting that permits the forecasting of current weights. This index also has the remarkable feature of tracking or predicting changes in the Fisher ideal index, while being able to be produced at the same monthly frequency as the CPI.

Thus, there are tools for correcting for substitution bias in a monthly index, or at least estimating those corrections. Yet, to my knowledge, no statistical agency has adopted the Shapiro-Wilcox approach. Perhaps statisticians think that there is too much statistical uncertainty involved in estimating the precise degree of substitution that has taken place, or that past substitution behaviour might not be a good guide to the present.

What statistical agencies have begun to do over the past decade is to use a superlative index such as the Fisher index, which avoids substitution bias, usually combined with *chain weighting*. In a chain-weighted or chained index, the past weights (going into the Laspeyres components) are always from the immediately previous time period and so are updated automatically every period, rather than intermittently. The US Bureau of Labor Statistics, for example, has issued a chained CPI at the national level – the so-called C-CPI-U, where C stands for chained and U stands for urban consumers – since August 2002. The index is first issued in preliminary form, and then is revised twice as data on expenditures become available. Figure 1 shows the 12-month inflation rates in the traditional US CPI-U (the black line) and new C-CPI-U (the grey line) since December 2000 (the earliest date to which the C-CPI-U applies is December 1999).

As expected, given the resistance to substitution bias in this index, the inflation rate in the C-CPI-U is systematically lower than that in the better-known CPI-U. For the 93-month period shown in

Figure 1: Inflation in the US CPI-U and C-CPI-U, January 2001 – June 2008



Source: Bureau of Labor Statistics, www.bls.gov/cpi/data.htm

the figure, the average US inflation rate was 2.86 percent in the CPI and 2.50 percent in the C-CPI-U, for an average difference of 0.36 of a percentage point. It will be interesting to track this difference, as well as the scale of revisions, over time.[4]

The Consumption Price Index as an Alternative to the CPI

Of course, Canada does use chained, Fisher indexes in the quarterly National Income and Expenditure Accounts. Among these, it would be natural to consider the chained price index for consumption (CPIC) as a potential target.[5] The US Federal Reserve monitors the corresponding US index, the personal consumption expenditure (PCE) deflator, so it is worthwhile to ask whether the Canadian equivalent might complement or replace the CPI as a target for monetary policy.

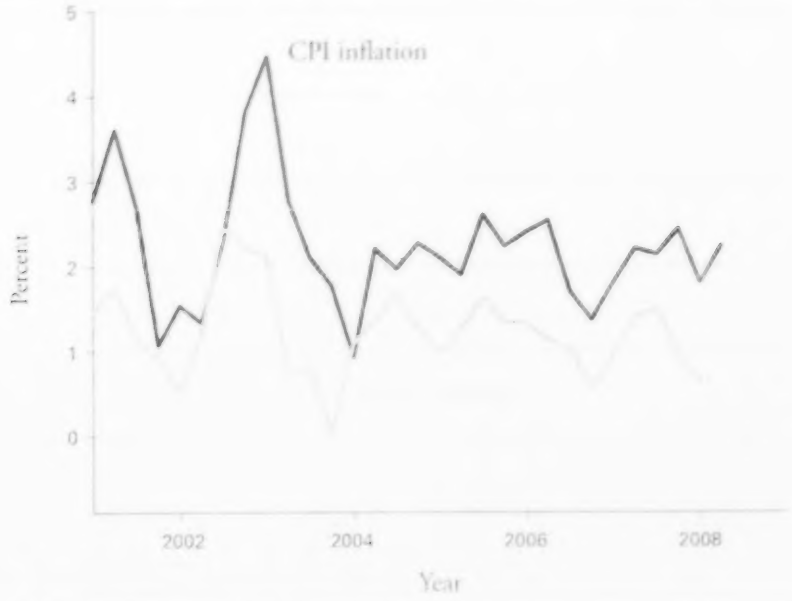
As Diewert (2001) notes, designing a consumption deflator uses different criteria than does designing a cost-of-living index. The CPIC is based on dividing nominal consumption expenditures by the chained, Fisher volume index and so is itself a chained, Fisher index (between the previous and current quarters). It is a weighted average of the Laspeyres and Paasche indexes but with continuously updated weights on the lagged expenditure pattern – that is, chaining. It thus avoids substitution bias, unlike the CPI.

What signal does the CPIC inflation rate give to policymakers? Figure 2 shows the quarterly average of the 12-month Canadian CPI inflation rate (the black line) and the four-quarter inflation rate in the implicit chained price index for personal

4 An extreme and inaccurate version of this adjustment takes place in Argentina, where the government requires its statisticians simply to remove products with rapidly rising prices from the official CPI basket, supposedly to combat substitution bias, but in fact deliberately to understate the inflation rate.

5 The GDP deflator does not make an appealing candidate as a target because it contains large shares of exports and capital goods and it gives imports a negative weight.

Figure 2: Inflation in the CPI and CPIC, 2001:Q1 – 2008:Q2



Source: Bank of Canada Banking and Financial Statistics, July 2008, tables H3 and H8.

consumption expenditures (the grey line), both since the start of 2001. As one would expect, given their construction, the CPIC inflation rate was less than the CPI inflation rate in every quarter. Over these 29 quarters, the average inflation rate was 2.23 percent in the CPI and 1.22 percent in the CPIC, a difference of 1.01 percentage points. This difference is an alternative to the Bank of Canada's measure of the bias in the CPI inflation rate. It is in the same direction as the Bank's estimate of 0.6 percentage points, but noticeably greater. And it might still underestimate the bias, because it omits both substitution bias at very fine levels of disaggregation (finer than the categories in the index) and bias due to quality improvements or new goods.

This average difference of 1.01 percentage points is also sensitive to the time period over which the averages are calculated. I do not claim that the bias is as large as 1.01 percentage points for all time periods. But variation in the average bias with the time period strengthens the case for switching to a superlative inflation rate, for that variation means that one cannot just subtract a constant, like 0.6 or 1.0, from the CPI inflation rate to get the superlative one.

Figure 2 also captures a disadvantage of the CPIC measure: the national accounts for a given quarter are issued with a lag of roughly two months, whereas the CPI is released with a lag of three weeks. Thus, as of late July 2008, we knew the CPI inflation rate for the second quarter of 2008 (which Figure 2 shows), but not the CPIC inflation rate for the same period. The CPIC measure has two other disadvantages, however, that Figure 2 does not capture. First, there is uncertainty about the measure's preliminary values, because of the possibility of later revisions; consequently, as Steindel (1997) notes, the CPIC might not send an accurate message about the change in the inflation rate even if it eventually is more accurate about the level. Second, the CPIC is recorded quarterly, whereas the CPI inflation rate is recorded monthly (although Figure 2 shows its quarterly average). The quarterly frequency of the CPIC also seems low compared to the Bank of Canada's eight fixed

action dates per year. That fact raises the question of whether higher-frequency observations of the 12-month CPI inflation rate provide valuable information. I discuss that question below when discussing the role of core inflation.

Reforms

Overall, there is a trend towards chained, Fisher indexes among statistical agencies. Perhaps Statistics Canada will follow this trend and introduce an analog to the US C-CPI-U based on a Paasche component that is either forecasted or released with a delay, or both. It might be hard to imagine economic analysts, tax authorities, wage bargainers, and central banks all switching their focus from the current CPI to an index with a longer delay and revisions, but such an index would be a useful complement to the CPI and provide an ongoing estimate of its inaccuracy, even if it did not completely replace the traditional CPI.

A second, very useful reform would be to update the CPI basket more frequently – say, annually. Currently there is the possibility of a saw-tooth pattern in the biases in CPI inflation, on a four-year cycle. With the current, 2005-based weights, the inflation rate might be overstated more in 2011 than in 2007, because the weights will be staler then.

The issue of whether or not a longer delay in learning a superlative price index matters is related, of course, to the targeting framework itself. If a central bank's goal is for every monthly value of the 12-month CPI inflation rate to lie in the 1 to 3 percent band, then it will want to learn this value as quickly as possible in case it needs to change course. Diewert (1983, 1998a, 1999) has suggested instead a target of the centred moving average of 13 months of the 12-month CPI inflation rate, or else one of five quarters of the four-quarter CPIC inflation rate. The idea is that this smoothing would eliminate seasonality and smooth the sometimes volatile fluctuations in the inflation rate. Whether we call this proposal smoothed inflation targeting or a variety of flexible inflation targeting, it would be less sensitive to the most recently reported price index and, therefore, to any delay in constructing the index. So, using an analog to the US C-CPI-U or else the CPIC might fit comfortably in such a framework.

I would argue, however, that were Statistics Canada to produce an analog to the US C-CPI-U, the Bank of Canada should simply target its 12-month growth rate. Waiting an extra month or two to learn a relatively accurate measure of inflation (and how well the Bank has succeeded in meeting its inflation target) seems preferable to the earlier revelation of a measure with a systematic bias of 0.6 to 1 percentage points. After all, this bias is 30 to 50 percent of the midpoint of the current target range for inflation, which is a large penalty to pay in accuracy in exchange for the early announcement of traditional CPI inflation. Immediacy matters less for the target than it does for the operational guide.

Updating the CPI basket more frequently, or introducing a chained, superlative, monthly replacement for the CPI would, of course, involve costs for Statistics Canada. My focus is on the use of indexes in monetary policy, so I leave it to the reader to estimate the effect on total federal government outlays of a reform that would significantly (and correctly) lower the measured inflation rate; how to index those outlays was precisely the focus of the US Boskin Commission.

Real and Financial Asset Prices

One of the most active subjects of debate concerning the CPI generally and its use in monetary policy in particular involves how it treats asset prices. When we think of the CPI as a cost-of-living index, it is natural to assume that it would include estimates of the cost of a flow of consumption services. But how an index treats durable goods prices – and how closely it captures the price of that service flow – differs significantly across countries. That means it is not as easy to compare the track records of different central banks as one would hope, even though all inflation-targeting banks use a CPI target.

How to Handle House Prices

There are four different ways to treat the price of a durable good in the CPI: (a) omit it; (b) use the

acquisition price; (c) calculate the rental equivalent; or (d) calculate the user cost.[6] Statistical agencies use (b), the acquisition price, for most durable goods, such as automobiles or furniture. For owner-occupied housing, all four approaches are in use. This choice certainly matters to measuring inflation, for housing costs can comprise a large share of the cost of living that the CPI attempts to measure.

The CPI that is used in the euro area and targeted in the United Kingdom uses method (a), giving zero weight to owner-occupied housing costs.[7] In the United States, the Bureau of Labor Statistics (BLS) uses (c), the rental-equivalent approach. Diewert (2003) explains how to implement this approach using either owners' estimates of rent or a statistical model that imputes (that is, estimates) rents to owner-occupied housing based on detailed information about the characteristics of the dwelling combined with actual rents on dwellings with similar characteristics. The BLS instead uses only actual rents, for which the agency has faced criticism because of persistent swings in the ratio of rents to house prices. These swings can last for years, so the choice of house-price measurement certainly can matter over the horizon with which a central bank is concerned. Moreover, since the ratio of market rents to asset values tends to fall as house values rise, the rental-equivalence approach tends to give too small a weight to housing in the CPI compared to the corresponding user-cost valuation. If house prices rise faster than prices in general, as in the recent past, this effect will lead CPI inflation to understate the true inflation rate or to be biased downward. If, instead, house prices fall faster than other prices, the CPI inflation rate will be biased upward.

The User-Cost Approach in Canada

Statistics Canada uses (d), the user-cost approach, which includes estimates of a homeowner's replacement cost (depreciation) and of mortgage interest cost (see Diewert 2003). Baldwin and Mansour (2003) show that measured CPI inflation is quite sensitive to the treatment of owner-occupied housing.

There are, however, two problems with Statistics Canada's treatment of housing costs. First, it includes only the mortgage interest cost as a user-cost component and not the opportunity cost of the equity tied up in a house. This omission tends to make their weight on housing too small. Second, a true user cost that tries to mimic market rents would include an estimate of the anticipated capital gain on holding the house (recall that depreciation raises the user cost of an asset, so appreciation lowers it), but Statistics Canada does not deduct this anticipated capital gain from its measure of the user cost. Omitting this factor – admittedly quite challenging to measure – tends to make its estimate of the user cost too high and the weight on housing too large. A constructive step might be for Statistics Canada to report several possible series (or components thereof) for owner-occupied housing. Researchers then could work with these series and perhaps reach a consensus on the empirical importance of the user-cost components.

Is the User Cost Too Responsive to the Overnight Interest Rate?

Some commentators argue that the inflation target should exclude components, such as mortgage interest, that are closely related to the central bank's policy tools. According to this argument, if the Bank of Canada were to raise its target for the overnight interest rate, with a view to lowering the future inflation rate, mortgage rates would rise as well, because these interest rates tend to move roughly in tandem with money-market rates. If mortgage interest were to be included in the CPI through the user cost of housing, then the CPI also would rise, which would yield an incorrect signal of the longer-term impact of the policy change.

Is this a case where the best cost-of-living index is not the best target for monetary policy? I think not. There are a variety of ways in which an increase in the general level of interest rates might be passed through by firms into higher prices. And the Bank

6 Diewert (2007) suggests a further refinement, the opportunity-cost approach, which takes the maximum of the market rent and the user cost.

7 The UK index that more closely resembles the Canadian CPI is the retail price index.

of Canada is an old hand at explaining that reacting to inflation expectations by raising nominal interest rates in the short run will lead to lower nominal interest rates (through the Fisher effect) in the long run. Similarly, the Bank does not argue that changes in its policy rate primarily cause changes in today's inflation rate.

Canada's core CPI, the CPIX, excludes mortgage interest costs precisely for this reason. (It excludes other items for different reasons, discussed below.) It is possible, then, that it helps forecast future inflation in the total CPI, but in itself that feature would not make the CPIX a natural candidate as a target.

Another criticism sometimes made of the user cost is that it varies widely across cities or regions, because house prices do. Again, though, regional CPIs can and do vary for a range of reasons. And the Bank of Canada also is accustomed to explaining that it targets a national average and that relative price changes (or inflation differentials) across regions convey valuable information to both households and firms.

Asset Prices and Inflation Targets

Of course, the prices of houses, as well as those of financial assets, also feature in debates on monetary policy for two additional reasons. First, asset prices might provide useful information about the future path of inflation – for example, through wealth effects on consumption spending – and so be useful indicator variables for central banks. Second, large swings in asset prices might be early warning signals of instability in the financial system, with implications for later employment or inflation.

Some economic research suggests that prices of financial assets should be incorporated directly in price indexes – although Diewert (2002, 560-65) has criticized this approach. For example, Reis (2005) has constructed a cost-of-living dynamic price index for the United States based on forecasts of lifetime prices, on which asset prices directly provide information. The underlying idea is to create a long-term index of changes in the cost of living over one's remaining life. The same good consumed at two different ages is treated as two different goods, and its prices on both dates enter the index. From this perspective, there would be a novel, added substitution bias in the CPI, because a consumer can respond to a high price by substituting over time – say, by waiting for a sale or even for a senior's discount – as well as over goods. This thought-provoking approach might well see further application in the future.

Lessons from Research on Optimal Monetary Policy

There is no reason an index that is best for measuring the cost of living should necessarily be the best target for monetary policy. Historically, central banks have often targeted such things as the price of gold or the price of a US dollar that have little to do with consumer welfare directly. But one certainly would want to consider the effects on consumers of the choice to target a specific index.

Inflation can affect consumers in a variety of ways. For example, an unexpected burst of inflation redistributes income from savers to borrowers, while unpredictable inflation can inhibit decision-making by making it difficult to disentangle changes in relative prices from changes in the overall price level. Inflation also can affect how resources are allocated if there are frictions in the economy, in the form of wages or prices that are locked in for significant periods of time or "sticky." In this section, I focus on this last effect, because economists have argued that these frictions matter specifically for the choice of price index that a central bank should target.

Formally, we can approach the question of what to target by first asking what distortions (such as sticky prices or real rigidities) give rise to a stabilization role for monetary policy, and then finding a price index that best reflects those distortions. Recent research on optimal monetary policy takes exactly these two steps. The word "optimal" in this research simply means that the central bank is tasked with designing policy to make the welfare of a typical household as high as possible. For example, optimal policy can involve varying the short-term interest rate to offset some other shocks that hit the economy, if households are not immediately able to adjust to those shocks on their own.

Before outlining the implications of this research, I note that there is a particular reason to pay attention to this approach in discussing the Bank of Canada's targets. The Bank's officers have said that they are researching the use of price-level targeting (or price-level-path targeting). There is little historical evidence to draw on in predicting the impact of price-level targeting, however, so macroeconomic models must perforce play an important role in assessing it. Today's macroeconomic models include a number of key, relative prices, so it is certainly worthwhile to ask what lessons they yield for the choice of target, too.

Targeting Prices in Sticky-Price Sectors

The basic idea in this research is that a careful central bank wants price stability (to minimize price-adjustment costs) and also wants to allow efficient and necessary changes in relative prices. The implication of this reasoning is as follows. If sector A has flexible prices and sector B has sticky ones, then the central bank should stabilize the price in sector B; sector A then will absorb any relative price changes (see Goodfriend and King 1997; King and Wolman 1998; and Aoki 2001).

With a range of sectors, varying in their stickiness, an index for policy to target would place more weight on stickier sectors. For example, suppose that wages and prices are both sticky. Then, if the central bank stabilizes prices, real wages often will be misaligned. Policy might do better by stabilizing a weighted average of wages and prices.

Mankiw and Reis (2003) offer an interesting example of this approach. Instead of using weights on individual or sectoral prices that reflect budget shares, they propose choosing weights so that, if the central bank targets the resulting index, then the economy will be as stable as possible. They call this the stability price index. The underlying idea is that there is an output gap that the central bank would like to stabilize but cannot observe directly. The output gap would be zero if prices were completely flexible, which is the situation the central bank tries to replicate. The bank learns about this gap, or the general state of the economy, by watching prices. Prices that are completely flexible or in sectors that are subject to large, idiosyncratic shocks do not provide much information on the output gap, while prices that are sticky or in sectors that do move with the overall cycle are more informative. A stability price index for monetary policy gives them a higher weight. When Mankiw and Reis apply their recipe to the United States, they are led to recommend a large weight on nominal wages, an indicator that does not even enter the CPI.

At the Bank of Canada, de Resende, Dib, and Kichian (2008) have developed a model of the Canadian economy with multiple sectors, each with frictions in adjusting to shocks. The frictions include costs in moving factors between sectors or in adjusting prices and wages. They find indirect evidence that the sector producing goods that are not traded internationally is the stickiest one, or the one with the most frictions. But they also calculate that the optimal policy target is the CPI inflation rate, not the inflation rate in this nontradable sector. The logic is that all sectors have frictions, so targeting nontradable inflation would place a burden of adjustment on all other sectors. Targeting CPI inflation is a compromise, with a lower average burden of adjustment. That approach reduces volatility in all sectors, and so leads to the lowest costs of reallocating resources. (There might be a weighting of sectors that does even better, but their insight that the index should involve all sectors remains valid.)

Wolman (2005) notes that there might be trends in relative prices across sectors that also differ by stickiness. For example, suppose that services prices tend to rise relative to goods prices over time – opera tickets gradually become more costly relative to laptop computers – and that service prices are relatively sticky. This approach then yields the recommendation that the Bank of Canada should try to stabilize services prices and let goods prices bear the burden of relative price adjustment. If it succeeded, the result would be an overall deflation.

Implications for Policy

The goal of minimizing adjustment costs that is built into these studies of ideal monetary policy might seem to rationalize focusing on core inflation as a target, not just as a guide. Suppose that there is a positive shock to gasoline prices and that those prices are flexible. If the Bank of Canada tried to

stabilize the CPI, its policy would depress demand and so lower inflation in the other, sticky-price sectors of the economy. But this would be inefficient. In the optimal-policy approach, the goal of policy is to make the economy operate as if prices were flexible, so as to save on adjustment costs. The ideal policy would keep core inflation and employment stable, while letting gasoline prices move around.[8]

However, the selection of prices to omit from the core CPI is based on volatility outcomes that do not necessarily reflect underlying frictions or costs of adjustment. Observing that lawyers adjust their prices less frequently than plumbers does not imply that members of the bar face high adjustment costs; they might simply experience fewer shocks. More broadly one might wonder how stable different price-setting customs are across sectors. Overall, then, the concept of targeting the apparently sticky sector does not yet seem to provide a way to improve on the CPI, the CPIC, or a new C-CPI as a target.

The Operational Guide: Core Inflation

The Bank of Canada distinguishes between its target, the CPI inflation rate (sometimes called "headline inflation") and its operational guide, core inflation. The idea underlying core inflation as an operational guide is that today's core inflation is a predictor of CPI inflation a year or more later. As a result, monetary policy that responds to the current level of core inflation, in the end, will influence future inflation appropriately.

Core inflation is measured with the CPIX – that is, the CPI excluding its eight most volatile components (out of 54 broad categories), with the remaining components adjusted for the effects of indirect taxes. The eight excluded components – fruit, vegetables, gasoline, natural gas, fuel oil, tobacco, intercity transportation, and mortgage-interest costs – account for roughly 16 percent of the Canadian consumption basket.[9] In this section, I outline five criteria that one might consider in designing a measure of core inflation: communicability, volatility, persistence, the degree to which it shares a trend with headline inflation, and the ability to forecast headline inflation. I also comment on which criteria guided the Bank of Canada in selecting its current measure, the CPIX.

Communicability

Superficially, the Bank of Canada's drawing attention to an inflation measure that excludes the cost of filling a gas tank or buying bananas might make it seem out of touch. Central banks that use core inflation as an operational guide often are criticized for focusing on an irrelevant index that excludes many of the things that are most important for consumers. So the first communication challenge associated with the use of core inflation is to explain what it is used for: as a guide to setting interest rates by virtue of its predicting future CPI inflation.

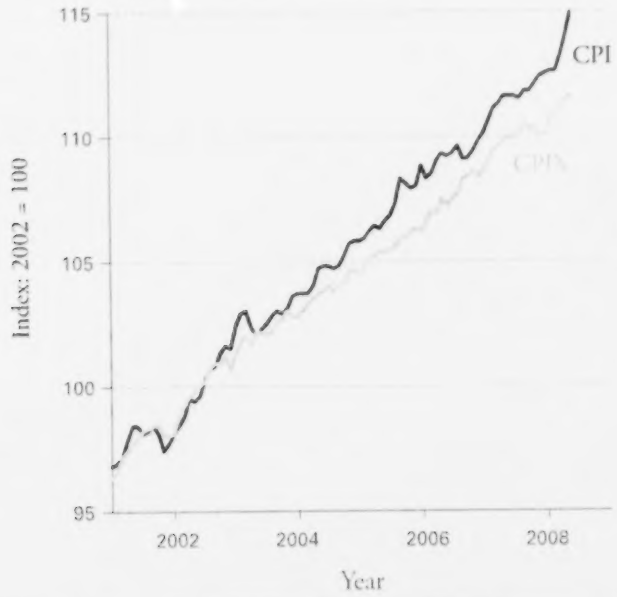
The second communication challenge is to explain how the Bank constructs the CPIX. Central banks experiment with core measures by (a) excluding some components (as in the CPIX); (b) reweighting components – as in Canada's CPIW, which weights components inversely to their volatility, or the core inflation measures MEANSTD and WMEDIAN, which are constructed by trimming the distribution of price changes to omit extreme values each month; or (c) using statistical methods to smooth headline inflation or isolate its low-frequency components. One of the best arguments in favour of measures found by exclusion, such as the CPIX, is that they are relatively easy to understand and explain. That feature makes it more likely that they will influence the expectations of future inflation that central banks seek to manage.

Understandably, central banks also evaluate measures of core inflation periodically – Laflèche and Armour (2006) describe a recent evaluation. From time to time they might find that a new measure has good statistical properties, but using

8 Bodenstein, Erceg, and Guerrieri (2008) provide a recent application of this approach.

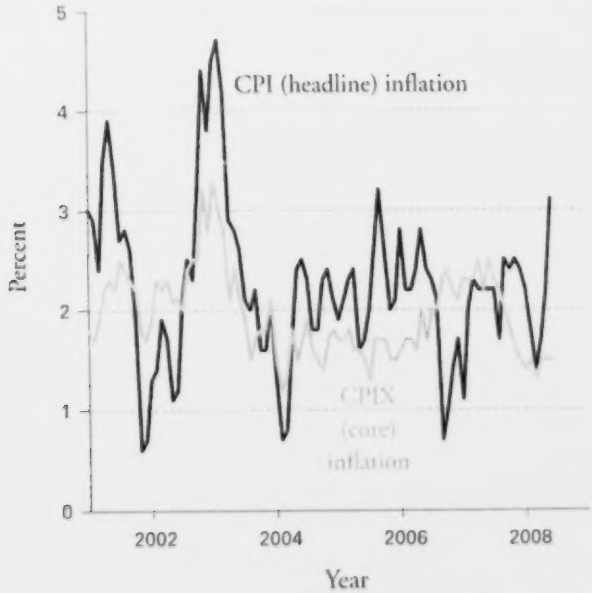
9 Macklem (2001) describes the development of the CPIX in Canada, while Laflèche and Armour (2006) provide an update on the properties of candidate ways to measure core inflation.

Figure 3A: Comparing the CPI to the CPIX, January 2001 – June 2008



Source: www.bank-banque-canada.ca/en/cpi.html

Figure 3B: Comparing Headline to Core Inflation, January 2001 – June 2008



Source: www.bank-banque-canada.ca/en/cpi.html

the same measure over time seems sure to help with communication.

Volatility

The eight components excluded from the CPIX are those that tend to have the most volatile prices. If price changes in these components are temporary, one would not want the Bank of Canada to respond to them by changing its target for the overnight interest rate. By the time the interest-rate change affected the economy, the price change would have been reversed, so a policy of reacting to changes simply would add cycles to the economy. Core inflation, which is what is left after excluding these volatile components, thus is a smoother series that better captures the trend in headline inflation, and using it means that policy reactions are less likely to need correcting.[10]

A pitfall with any measure of core inflation, however, is that it can create the false impression that some prices matter more than others. The idea that policy should not be guided by the prices of gasoline and bananas today is, in fact, consistent with the Bank of Canada's concern about all prices in the future. Focusing on core inflation also can create the false impression that inflation is caused by changes in relative prices, as Laidler and Aba (2000) note. Assuming that banana prices can be overlooked in forecasting inflation does not mean that an increase in the price of bread – which is in the CPIX – is inflationary.

Persistence

What if a change in relative prices is permanent, rather than temporary? As Mishkin (2007) discusses, even under this scenario, the central bank should not necessarily react to the departure of headline inflation from core inflation. If there is a one-time, permanent change in the price of gasoline, for example, that will appear as a spike in the inflation rate, but it will not necessarily cause an ongoing inflation. Of course, if there were a trend in the relative prices of the eight components excluded from the CPIX, then core inflation would work badly as a forecast, especially since these items comprise a significant share of spending for households most affected by inflation.

One would suppose that persistent or permanent changes in relative prices would be more likely to feed through into ongoing inflation – that is, to have so-called second-round effects – perhaps by influencing inflation expectations. If that is the case, persistence probably should count against candidates for exclusion in defining core inflation. I have not seen this issue discussed directly in Bank of Canada documents as a design criterion, though there is no doubt that officials closely monitor persistence in practice.

Figure 3A shows the CPI and the CPIX since 2001; Figure 3B shows the same series, but in 12-month growth rates. Note that core inflation is much less volatile than headline inflation. But just as evident is the fact that the differences have been quite persistent at times.

A Common Trend

For core inflation to influence expectations, it would be helpful if it shared a common trend with headline inflation. Looking back at recent inflation history, one would like the average core inflation rate to be very similar to the average headline rate. Over the 90 months from January 2001 to June 2008, however, the average rate of headline inflation was 2.24 percent, while the average rate of core inflation was 1.95 percent. This comparison can be sensitive to the time period being used, but this is a substantial difference.

Recall that Figure 2 showed that the CPIC inflation rate also was below the CPI inflation rate during this time period. The reader might wonder if the CPIX could act as a proxy for the CPIC, so that targeting the monthly CPIX would sidestep

10 As a brief technical note, exclusion could be based on the volatility of individual components or of the entire group. It is possible that, although the prices of both gasoline and bananas are volatile, they might be negatively correlated, so that an average of the two prices is not volatile. In that case, omitting the combination would not necessarily make core inflation less volatile than headline inflation. In practice, though, this syndrome does not seem to arise; correlations among those omitted prices are relatively small, so excluding components based on their individual volatilities does make core inflation relatively smooth.

the issue of substitution bias in the CPI inflation rate. Unfortunately, this pattern can just be a coincidence. Omitting volatile items, to produce the CPIX, need not yield an index that mimics a superlative one.

Core inflation could be *defined* as the trend component of inflation, or as the common component of inflation in a set of individual prices. Reis and Watson (2007) estimate a statistical model that divides the inflation rates of 187 components of the US PCE deflator into a common component and relative price changes. The common component, which they call pure inflation, is defined to have an equiproportional effect on all prices and to be uncorrelated with relative price changes. Reis and Watson find that most variation in US inflation, especially since the 1990s, has reflected relative price changes, not variations in their pure inflation measure.

Forecastability

Economists often argue that core inflation should help to forecast headline inflation, and central banks sometimes use this as a criterion for selecting a core measure. In fact, today's core inflation rate might be even better than today's headline inflation rate at forecasting future headline inflation. As we have seen, the ability to forecast the target inflation rate is a good property for an operational guide to have, because of the delayed effects on inflation of changes in monetary policy.

The forecasting criterion explains why mortgage-interest cost is excluded from the CPIX. This component of the CPI is not especially volatile, unlike the other components; it is excluded because it varies quite directly with changes in the target for the overnight interest rate and so does not provide information on the future path of inflation (or perhaps even does so with the wrong sign).
To assess or select a core measure based on the forecasting criterion, economists look for a statistical relationship between headline inflation in a given month and core inflation in previous months, especially at lags such as 12 to 24 months, over which policy changes affect prices. They test this relationship using so-called real-time methods, being careful to fit a regression line using only data points that were available at the time forecasts were being made.

Unfortunately, two problems arise in designing or testing core inflation measures this way. First, suppose one defines core inflation by excluding various components of the CPI to maximize the forecasting record of what remains. (Of course, if this is the design criterion, it cannot be a separate evaluation criterion for the same time period.) Usually, other economic indicators help to forecast inflation, too. For example, today's unemployment rate or the location of headline inflation in the 1 to 3 percent target band might also be useful in predicting headline inflation. Devotees of core inflation do not argue that it is the only variable needed in forecasting, but these multiple indicators can give conflicting signals about future inflation in some months. That conflict might make it difficult to use core inflation as a guide for the public and the basis for inflation expectations.

The second problem is more subtle. Imagine a world with a central bank that succeeded in keeping the inflation rate at exactly 2 percent. A statistician in this world would look in vain for any variable to help forecast the inflation rate. The same sort of inability to forecast would arise if the inflation rate departed from 2 percent but only for short periods of time. Those blips in inflation would not be predictable 12 to 24 months in advance. Under successful inflation targeting, nothing (other than the number 2) should help forecast inflation. In fact, a pattern of forecastability, where departures from 2 percent could be predicted well in advance, would show that there was room for improvement by the central bank. For example, if a high unemployment rate this month predicted an inflation rate below 2 percent in 18 months' time, that pattern would suggest the central bank should make its overnight interest rate more responsive to today's unemployment rate. Rowe and Yetman (2002) make this argument in the context of Canadian inflation targeting, and document how challenging it was to forecast inflation once the Bank of Canada began targeting it. Clinton (2006) applies this argument to core inflation, arguing that core inflation does not, and should not, help forecast headline inflation.

A Final Comment on the Five Criteria

What conclusions can we draw from these five criteria? One is that they might conflict – a core measure constructed by omitting some volatile prices might not necessarily have a common trend with the CPI or be a good predictor. For the United States, for example, Rich and Steindel (2005) find that there is no single, best measure based on the criteria of communicability, common trends, and forecasting. It seems hard to escape the conclusion that it might be better simply to use as an operational guide either the Bank of Canada's inflation forecast or the second missing link: private sector inflation expectations. As Macklem (2001) notes, those who advocate the use of core inflation do not argue that it can be the sole guide – in trying to forecast inflation, there is no reason to restrict oneself to using the CPI, either reweighted or minus some components. Some central banks, like the Bank of England, present their own inflation forecasts in so-called fan charts that depict margins of error that "fan out" into the future. But there is something strange about a central bank's targeting 2 percent inflation yet reporting an unconditional forecast that differs from that value. Moreover, the central bank's forecast naturally could differ from the forecasts or expectations of firms, and it is the latter that one is really interested in, because they affect price setting today and the evolution of headline inflation.

Inflation Expectations

We can learn about inflation expectations most directly in two ways: from bond markets or from surveys of forecasters. Let us look at the ideal and then at the Canadian reality in each case.

Measures from the Bond Market

Imagine two discount bonds with the same issuer (say, the Government of Canada), maturity (say, 12 months), tax status, and liquidity (say, high). One is indexed to CPI inflation and one is not. The difference between the yields on these two fixed-income instruments then would serve as an estimate of the expected, 12-month inflation rate, 12 months in advance. This difference is sometimes called the break-even inflation rate.[11] The appeal of a market-based forecast such as this is that investment actions might be worth more than survey words.

Break-even inflation rates are widely cited for several countries. The Bank of England reports a two-year break-even rate derived from the longstanding market for indexed, gilt-edged securities. In the United States, the Federal Reserve Bank of Cleveland tries to correct for liquidity differences and an inflation risk premium in the difference between the yield on US Treasury inflation-protected securities (TIPS) and the corresponding unindexed yield; the maturity in the TIPS case is 10 years.

Unfortunately, Canadian real return bonds have a 30-year maturity, and seem to be considerably less liquid than conventional 30-year bonds. Christensen, Dion, and Reid (2004), who provide an excellent review and assessment of deducing inflation expectations from these instruments, conclude that, because of these maturity and liquidity characteristics and other features of the bonds, the break-even inflation rate in Canada is not particularly useful as an inflation forecast. A solution to this problem would be for the Government of Canada to issue real return bonds with maturities of, say, one, two, and five years. An active indexed debt market at these maturities would enrich the opportunities for savers and provide valuable indicators for the design of good monetary policy.

Forecast Surveys

The alternative to reading the fixed-income tea leaves is simply to ask some people their forecasts of the inflation rate. Here the ideal probably would be to ask professional forecasters or price-setting firms and unions each month (or perhaps each quarter) to predict the 12-month CPI inflation rate for several horizons out to 18 months. The average of their forecasts would be a very useful guide. One thing we know about forecasting is that pooling works. The average of a group of forecasts very

11 In practice, the difference could reflect a risk premium differential, too.

often is more accurate that any sequence of predictions from an individual forecaster. Also ideal would be to report individual forecasts, not just the mean or median, so that the dispersion could be used to measure uncertainty.

One of the best examples of such a survey is the *Survey of Professional Forecasters* conducted quarterly by the Federal Reserve Bank of Philadelphia. This survey allows forecasters to remain anonymous, but most choose to report their participation (although their specific forecasts are not identified). Its historical files provide individual forecasts. The variables forecasted include quarter-to-quarter changes in the CPI and several other price indexes over the next four quarters as well as for five and ten years. The survey is freely available to the public. Another example is the Banco Central do Brasil's survey, which solicits information from numerous analysts.

In Canada, forecast surveys are not quite as useful for studying monetary policy, which might be why they do not attract as much attention from financial analysts. The Conference Board of Canada conducts a valuable *Survey of Forecasters* each quarter. Unfortunately, the forecasts are on a calendar-year basis (rather than having a fixed horizon), the survey reports only the mean, and the number of participants is small (six in summer 2008). Consensus Economics Inc. conducts a monthly survey that includes Canada; it provides individual forecasts, but, again, only for calendar years. Although the Consensus Economics surveys are available only by paid subscription, the Bank of Canada is able to report the average inflation forecasts in its quarterly *Indicators of Capacity and Inflation Pressures for Canada*. Statistics Canada does not survey households or firms for their inflation predictions.[12]

The Bank's own Business Outlook Survey could be a fruitful source of information. Conducted quarterly since 2004, it surveys about 100 firms in sectors representative of GDP. It asks firms their forecasts of CPI inflation over the next two years, then reports the responses grouped into percentages in four ranges: below 1 percent, 1 to 2 percent, 2 to 3 percent, and above 3 percent. Since two of the categories in this histogram are unbounded, however, there is no way to estimate the average forecast. This horizon seems useful for debates about monetary policy though, so ideally the Bank would report the cross-forecaster mean and variance (if not the entire distribution) to serve as an expected inflation series.

With no widely accepted measure of inflation expectations from bond markets or surveys, Bank of Canada watchers and analysts could take the do-it-yourself approach and construct their own index designed to forecast inflation. Every quarter, the Bank provides a long list of *Indicators of Capacity and Inflation Pressures for Canada* that includes core inflation and a measure of the output gap, among many other variables. It should be possible to construct an index of these indicators, designed to forecast future CPI inflation, and track its departures from 2 percent. When there are large changes in relative prices, whether temporary or permanent, one then could track whether this index changes in response. If such an index had a good track record at forecasting inflation, inflation expectations might even come to coincide with it over time.

Conclusion and Recommendations

In this *Commentary*, I have asked two questions about the price index used in inflation targeting. First, what index should the Bank of Canada target? Second, what index should it use as an operational guide?

On the subject of the target, I have argued that the CPI continues to be an appropriate target for monetary policy, in part because it is available frequently and with no revisions. If technical improvements to reduce bias in the CPI inflation rate are difficult or slow in coming, the inflation-target band could be set to allow at least for the average bias. Because of its familiarity and coverage, the CPI can be used readily to communicate the benefits of a low level of inflation. Some recent

12 Statistics Canada formerly conducted a monthly *Short-Term Expectations Survey* that asked about forecasts for CPI inflation. The average number of participants was 17, and the agency reported only the cross-forecaster mean. The inflation rate forecast was for the 12-month change in the CPI, one month in advance. This is not a particularly challenging or interesting forecasting exercise. After all, when it comes to predicting next month's value for the 12-month growth rate of the CPI, 11/12ths of the outcome are already known. The survey ran from 1998 to 2000 and was then discontinued.

economic research emphasizes the possibility of superior stabilization of the economy using alternative targets. But economists have not yet made a convincing case for the differential stickiness across sectors of the economy that would underpin an index that would be preferred to the CPI.

However, although the CPI is the best available index for inflation targeting, it could be improved. The arguments I have presented in this *Commentary* lead me to make five recommendations for the target index, in order from least to most radical.

1. The Bank of Canada should revisit its estimates of the bias in the CPI inflation rate on a regular timetable, rather than intermittently.
2. Statistics Canada should update its CPI basket more frequently than every four years. Ideally, the updating would be annual. (The existence of the CPIC does not obviate the need for this; it, too, uses stale weights that are several years out of date.)
3. Statistics Canada could improve its treatment of owner-occupied housing in the CPI, and perhaps also release information that would allow researchers to study alternative treatments.
4. Statistics Canada should try to estimate a monthly, chained, superlative index (with a delay) as the US Bureau of Labor Statistics does with its C-CPI-U. Despite the delays and revisions that naturally arise with this sort of index, it would improve our tracking of inflation and so would complement the existing CPI.
5. I would go further and argue that the Bank of Canada should target the inflation rate in this new, superlative index instead of the CPI inflation rate. We currently use the realized inflation rate to assess monetary policy; under this recommendation, we would wait an extra month or two to learn the realized value of the target. This approach would be better than the status quo, where, although we quickly learn an estimate of the true inflation rate, it might have a bias that is a large share of the target itself.

Prompt availability of information certainly does matter for the operational guide, though. On this second subject, I have argued in favour of a measure of inflation expectations (rather than core inflation) as a guide and a focus of communication. The absence of an accepted measure of inflation expectations in Canada is striking considering the remarkable consensus among policymakers and research economists about the practice of good monetary policy and about the appropriate targets and instruments.[13] And the success of Canadian monetary policy has contributed to this consensus.

Inflation expectations play a key role in this consensus approach. It is not necessarily unscientific to use economic models involving variables that we cannot directly observe, such as the output gap or inflation expectations. But there are ways to measure inflation expectations that we have not yet taken advantage of in Canada.

Finally, then, on filling in this second missing link, I have two recommendations concerning the operational guide:

1. The Government of Canada could issue real return bonds with maturities of one, two, and five years.
2. A combination of institutions could regularly survey professional forecasters, so that we gradually assemble a panel of their inflation forecasts.

If the Bank of Canada followed either of these recommendations, it would no longer have to track which exclusions or re-weightings give a single, core inflation rate that best forecasts headline inflation. The Bank's periodic assessment of core measures is admirable, yet somehow also worrying, as it implies that the underlying statistical links might not be very stable over time. A market-based or survey-based measure automatically would reflect a mixture of sources of forecasting information that evolves over time. Moreover, whether it used the expertise of bond traders or of professional forecasters, such a measure would embody one thing we know about forecasting: pooling across forecasters adds to accuracy through the "wisdom of crowds."[14]

13 Clarida, Galí, and Gertler (1999), for example, refer to "the science of monetary policy," while Goodfriend (2007) outlines "how the world achieved consensus on monetary policy."

14 This phrase is borrowed from Surowiecki (2004).

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